GENERAL SECRETARIAT
OF THE INTERNATIONAL TELECOMMUNICATION UNION

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REPORT
ON THE ACTIVITIES OF

THE INTERNATIONAL TELECOMMUNICATION UNION

in

1960

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Published by the
INTERNATIONAL TELECOMMUNICATION UNION
GENEVA, 1961

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Council, the Coordination Committee, the Pension Fund Management Board, the I.T.U. New Building Committee, the Personnel Reclassification Review Board and the Purchasing Committee.

It will be recalled that the IXth Plenary Assembly of the C.C.I.R. took steps to obtain a more even distribution of work connected with Study Group documentation. The Director is glad to be able to report that these measures have been successful, as a number of documents concerning Questions on the programmes of the various Study Groups have already been received well in advance of the next Plenary Assembly, which is scheduled to take place in 1963.

4.5.5 *Technical Work*

Close collaboration was established with the I.F.R.B., in particular, concerning the preparatory work for the European Special Regional Conference, held in Geneva, April-May 1960, in early preparatory work for the European VHF Broadcasting Conference, which is to be held in Stockholm in the summer of 1961. and in implementing Resolution No. 3 of the Administrative Radio Conference, concerning studies by a panel of experts on measures to reduce congestion in the frequency bands between 4 and 27.5 Mc/s.

Studies were continued on a number of technical and scientific problems assigned to the C.C.I.R. Secretariat, notably on the prediction of sunspot numbers, which is also of great importance to the I.F.R.B. in connection with the preparation of HF broadcasting tentative schedules in accordance with the decisions taken by the Administrative Radio Conference, Geneva (1959) and the establishment of HF broadcasting plans.

4.5.6 *Technical Assistance*

The Director, taking Recommendation No. 2 of the Plenipotentiary Conference as a basis, suggested to the Members of the I.T.U. that specific participation of the C.C.I.R. in this field might well be most suitably arranged by means of a special Study Group set up for this purpose. While the majority of the Administrations replying agreed with this suggestion, the total number of responses (approximately 35% of the total membership) appeared to be insufficiently representative to warrant such a new departure without further consultation, which was instigated towards the end of 1960. It was decided to defer action until the results of discussions on this subject at the C.C.I.T.T. IInd Plenary Assembly became available.

Further studies were made concerning the design of low-cost receivers for new and developing countries, a question which had been assigned to the C.C.I.R. by the Radio Conference, on a proposal by UNESCO.

4.5.7 *Meeting of Experts*

Finally, the Secretariat, upon the request of the Swedish Administration, undertook preparatory arrangements for a meeting of experts, charged with preparing the technical bases for the European Regional VHF-UHF Broadcasting Conference, to be held in the summer of 1961.

4.6 The activities of the International Telegraph and Telephone Consultative Committee (C.C.I.T.T.)

4.6.1 *Study group activities*

In 1960, this Consultative Committee was above all concerned with its Second Plenary Assembly (New Delhi, December).

Nevertheless, the study groups were exceedingly busy. From January to October, they, or their working parties, spent, in all, no less than a hundred and thirty-eight days in meetings. In addition, they met in New Delhi immediately before the Plenary Assembly, from 21 November to 17 December, 1960.

The findings obtained by them received the sanction of the Assembly. An account of this will be found under the section dealing with the Assembly itself.

Apart from this, the first meeting to deal with a new field of telecommunication—data-transmission—was held in Geneva in March, 1960.

Furthermore, the Plan Sub-Committee for Latin America, set up by the Plenipotentiary Conference in 1959, met for the first time in Mexico City (April, 1960). It made plans for a network extending from the United States to Argentina (over six thousand miles in length), which gives rise to some difficult problems of telephone transmission performance. The Sub-Committee's findings were referred to a meeting of experts convened by the Organization of American States.

In a similar field, the Sub-Committee for Asia met in New Delhi immediately before the Plenary Assembly, and finished what it had begun in Tokyo in 1959.

4.6.2 *The Second Plenary Assembly*

The Second Plenary Assembly met in New Delhi from 8 to 16 December. Mr. Nehru, the Prime Minister, and Dr. Subbarayan, Minister of Transport and Communications in the Indian Government, did it the honour of attending the first meeting.

Thanks to India's generous invitation, a plenary assembly dealing with telegraphy and telephony was able to meet outside Europe for the first time, an event which marked the metamorphosis of the C.C.I.T.T., hitherto rather narrowly concerned with European problems, to a body of worldwide pretentions. This extension in the Committee's activities is attributable to the growth in means of transmission between continents and to the introduction of automatic or semi-automatic working in intercontinental communications, thanks to which the networks of all countries have become inter-dependent. It is attributable, too, to the interest now taken by the Committee in the problems peculiar to the under-developed countries.

Fifty-four Administrations from Members of the Union, from all over the world, seventeen recognized private operating agencies and eight international organizations, were represented in the Assembly. Twelve countries, some of which had only just become independent, were taking part in the Committee's activities for the first time. All in all, three hundred and forty-two delegates, representatives, experts and observers attended the meetings in New Delhi, two hundred and forty of them attending the Plenary Assembly properly so called.

The Plenary Assembly (Chairman: Mr. R. C. Vaish, Head of the Delegation of India) achieved major results in all fields. The premises, equipment, and organization, for which the Assembly had the Indian Government to thank, were an important factor in this success.

The work done by the Assembly represents the fruit of four years' work by the study groups, the reports and draft recommendations of which were adopted. The following is a succinct account of the work done in each branch of the Committee's activities.

4.6.3 *Transmission questions*

The relevant study groups considered a new transmission plan. The existing recommendations laid down only the equivalent for international circuits, and general limiting figures for the reference equivalent on national systems. The new plan gives detailed rules for the equivalent of international circuits and of the national trunk circuits which may be connected to them by four-wire switching, thanks to which the following objectives should be simultaneously attained:

- the quality of most medium-distance telephone calls should be improved,
- in very-long-distance calls (up to 15,000 miles or thereabouts), which will be available very shortly, the quality should be comparable to that at present offered by medium-distance communications by cable or radio relay.
- it should be possible to cut out singing in all calls and to reduce echo, without having to use too many echo suppressors.

The Plenary Assembly approved the recommendations leading to stability in communications and to a certain reduction in echo effect. Additional investigations will be carried on between 1961 and 1964.

Detailed specifications were worked out for the 12 Mc/s system, which offers 2,700 telephone channels on a coaxial pair of a kind already standardized by the C.C.I.F. The use of this system for the simultaneous transmission of telephony and television is still under consideration. Great progress has been made in the standardization of coaxial cables of smaller diameter and in the drawing-up of specifications for transistorized equipment offering threehundred telephone channels on a pair of this kind.

Recommendations were made about balanced-pair transistorized cable carrier systems.

The apportionment of work between the C.C.I.T.T. and the International Electrotechnical Commission in standardization of cables was more accurately defined.

4.6.4 *Maintenance*

The Maintenance Study Group made a thorough investigation of transmission performance on cable circuits (European system, trans-atlantic underwater cables), observing incidents, abrupt interruptions in transmission lasting several milliseconds, noise peaks, etc.).

It investigated, to this end, a number of specially-chosen circuits. Its findings were carefully analysed, and the lessons learnt therefrom should prove extremely useful.

An investigation has been begun with a view to defining an automatic transmission measurement device, so that, henceforward, it should be possible to do away with circuit testers.

4.6.5 *Telephone operational and switching questions*

The major advances here have been made in the new field of fully-automatic international telephony. Principles have been laid down for the apportionment of charges between the Administrations concerned, and the requisite metering devices have been defined.

There has been a standardization of the national ringing and busy-flash tones, so that a subscriber in country A, hearing a tone from country B, may know beyond all manner of doubt what that sound signifies. In view of the very varied tones used by different countries and the fact that changes imply alterations in all national centres, the choice of the frequency ranges and admissible rhythms for the tones was a matter of no little difficulty.

Statistical investigations of traffic were undertaken, with a view to determining the busy period and to evolving an unambiguous definition for it. They will continue in the period from 1961 to 1964.

Lastly, the study groups dealing with rates had some misgivings about the standardization of rates for the lease of circuits, be they telegraph or telephone. Study of this matter will have to be continued.

4.6.6 *Protection*

The Plenary Assembly approved most of the texts to be included in the new edition of the Directives for the protection of telecommunication lines against the unwelcome action of power lines.

The text for a new edition of the Recommendations for the Protection of Cables against Corrosion was given a final polish. This volume will have coloured photographs showing characteristic instances of corrosion. It will be fully up to date, especially as regards the use of cathode protection and of cables with sheaths made of substances other than lead (aluminium, plastic materials, etc.).

4.6.7 *Telegraphy and data transmission*

The requisite standardization for a steadily broader use of frequency modulation in telegraph transmission was defined, and the conditions governing line-of-sight radio relay in telegraphy were defined. Because of the tendency to use telegraph channels in which speeds greater than the ordinary can sometimes be used, recommendations were adopted in this matter.

Because telegraphy is making ever greater use of switching, both in telex (for subscribers) and gentex (for the public network of Administrations), a world-wide telegraphic distortion apportionment plan had become essential. Agreement was reached on this important point.

Difficult problems arise in international signalling for switched telegraphy (automatic interconnection of existing networks). Great progress was made here.

The use of switching on long circuits may render switching with accumulation of messages and retransmission preferable to full switching. A study of the problems thus arising internationally has begun.

As far as telegraph apparatus is concerned, the tendency now is towards the use of faster-working equipment in certain instances. To this end, agreement was reached on preliminary standardization at 75 bauds. The question of a new international telegraph alphabet, offering a wider scope than the existing one, has given rise to numerous studies, but the technical and financial problems involved are considerable and no final solution is yet in sight.

In facsimile telegraphy and phototelegraphy, once again the tendency is towards higher speeds and the introduction of switched services. Much progress has been made, thanks to the introduction of an international standard tuning pattern for tests.

International telegraphy has had to cope with the revolutionary changes introduced by switched operation. The operating procedures for the telex service and gentex network were reviewed and brought up-to-date. A closer definition was evolved for the use of page-printing receivers.

With regard to rates and charges, on the other hand, there is little to say, since most of the problems were settled by the Special Assembly in 1958. A study was made of the cost of automatic telex calls. Rules for the lease of circuits are still under consideration.

For data transmission, telecommunication operating authorities are faced with new and difficult problems. Telegraph-type pulses have to be sent at very high speeds over circuits not designed for that purpose. Hence such pulses are exceedingly fragile, if the word is permissible, while the permissible rates of error in this service are much lower than in telegraphy. Nevertheless, an agreement was reached on the limiting power for such signals.

4.6.8 *Vocabulary*

Detailed proposals for a thorough overhaul of the List of Essential Telecommunication Terms were adopted by the Plenary Assembly, and the review in question will be undertaken. This will be a matter of several years. The revised List will contain terms and definitions in Spanish and Russian as well as in English and French. The terms will also be included in German, Italian, Dutch, Polish, and Swedish.

As an intermediate stage, a supplement will be issued to the existing (1957) edition, comprising additional definitions, or modified definitions, approved by the Assembly.

The Assembly decided, too, that the Committee, in cooperation with the International Electrotechnical Commission, would draw up a list, applicable internationally, of telecommunication symbols.

4.6.9 *The Plan and Technical Assistance*

In accordance with the instructions give by the Geneva Plenipotentiary Conference, the Assembly gave a good deal of time to questions of concern to the under-developed countries. It asked the Plan Committee to prepare the ground for the study of such questions, and to this end endowed it with Sub-Committees for Africa, Latin America, and Asia.

Each of these Sub-Committees will be called upon to draw up a plan for development of the international networks in that part of the world with which it deals. In the light of this plan, it will make a list of technical and operating problems arising therein. These problems will be dealt with by the Sub-Committee itself or referred to the competent study groups.

The Assembly set up, too, a temporary committee to consider the problems to which creation of the Inter-American Telecommunication Network gives rise.

The Plan Committee, together with the Inter-American Telecommunication Network Committee, are joint bodies made up of representatives from the International Radio and International Telegraph and Telephone Consultative Committees. Hence the decisions taken by the Plenary Assembly will have to be confirmed by the next Plenary Assembly of the C.C.I.R.

Considerations in Choosing a Character Code for Computers and Punched Tapes

By H. McG. Ross

The Computer Journal
January 1961
vol 5 no 3 ↖ 4?

The considerations affecting the choice of a code for alpha-numeric characters are discussed, the primary aim being to assist processing of commercial data in a computer system. A basic 6-bit code is obtained from which 7- and 8-track punched-tape codes are derived; minor variants of these may be realized on existing data-preparing and printing equipment. The scheme permits future development in a variety of directions, including a compatible code for extended alphabets.

Introduction

In this country there is a growing interest in the rationalization of the codes used in computers and for punched paper tape, magnetic tape, and punched cards. The motive forces behind this are twofold: first, there are many within the computer industry who would like to avoid a multiplicity of codes which differ in detail but which all aim to attain the same basic ends; secondly, there are certain large organizations which may possess computers of different makes and have the need to be able to transfer data from one computer to another. Often there will be large quantities of such data.

Special interest lies in a code for 7-track punched tape because this is obviously going to become widely used, while, in Britain, there are at present no vested interests in any established codes. This is clearly an opportunity to avoid a repetition of the situation where, in Britain, there are four or five codes in use for 5-track tape and, in America, there are known to be over 25 different codes in use for the 6-bit characters within computers! Also, 7-track punched tape can provide perhaps the best "common language" medium for equipment used with computers. Already many office machines can be fitted with tape punches which permit data tapes to be obtained as a by-product; in certain applications check-sums can be used to ensure that the manual keying and other operations have been done correctly. In this work, 7-track tape permits sufficient flexibility to hold out the prospect of a uniform code; 5-track tape, however, is so limited that it is difficult to avoid the need for special codes. 8-track tape, while of less immediate importance, offers the prospect of future advance beyond the 7-track tape code.

The work described here was initially concerned with establishing the most satisfactory code to be used within the Ferranti Orion and Atlas computer systems and, as corollaries, the codes for punched paper tapes and magnetic tapes. It was soon found, however, that it was linking up with similar studies being carried out within the Electronic Engineering Association and the British Standards Institution, and also in the Electronic Industries Association of America. As the outcome of much discussion, the first proposals have been broadened and extended, and it is believed that the resulting scheme is capable of quite extensive application.

Code within Computer

It is considered that the right way to establish a code for punched tape is first to consider the code which is most convenient to use within the computer or data-processing system. In Orion and Atlas, as well as many other computers being designed and made in Britain, it is preferable to use a 6-bit code for alpha-numeric characters. The 64 possible combinations permit about 50 printing symbols (after allowing for control and function characters), which is rather more generous than is common in punched-card systems; it fits well into computer words and permits reasonably economical design of circuits to manipulate such characters directly. An important consideration is that 6 bits give a good compromise between the number of available characters and the effective use of storage space; if more bits were to be used, the cost or capacity of core stores, magnetic drums, and magnetic tape would be impaired, and the rate of transfer of data to and from magnetic tapes would be reduced.

Using ordinary binary notation, these 6-bit characters will have values lying between 0 and 63. However, it is sometimes convenient to group the characters into 4 zones, 0 to 3, with positions 0 to 15 within each zone. The 2 most-significant bits in each character give the zone and the 4 least-significant give the position.

To ensure that the code shall be most generally useful, particular attention has been given to providing the maximum number of facilities which experience has shown to be valuable; in practice, probably no one data-processing system will be able, or even need, to exploit all these facilities.

The code has been designed to meet the following requirements:

(*a*) To increase the performance of the computer system (there are several details of coding which each contribute 1% or more to the overall efficacy), and minimize the cost of the equipment.

(*b*) To make it easy to perform and comprehend the data-processing operations in the system; this simplifies programming and avoids confusion.

(*c*) The codes are to be based on a binary equivalent notation with numerals (including 0, 10 and 11) in numerical sequence, and the alphabet in consecutive alphabetical sequence. The latter depa

vol 3 #4 Jan 1961
from TCJ online

from a code based on punched-card practice, and has been a source of great argument. It is found, however, that when facilities have been provided in a computer system to deal with any of the more complex card punching practices, it becomes relatively easy to convert between card codes and the proposed computer code.

(*d*) From (*c*) it follows that the number zero should have position-value zero, etc., and it has been found preferable that letter A should have position-value 1, B, 2, etc., as in most British 5-track computer codes.

(*e*) The code is arranged so that tapes may be easily processed by input routines as they are read into the computer.

(*f*) The functions which are used to control printing machines, etc., are grouped together, and have low values.

(*g*) Several characters, with values smaller than those of the letters, are to be provided for terminating groups of alphabetic data.

(*h*) For reasons associated with sorting, the values of certain characters should lie in a particular sequence, thus: Space; / (which is used as a separating symbol in part numbers, for example); numbers from 0–9; letters.

(*i*) The numbers and the essential symbols associated with numerical data (particularly the symbols + − and .) are to lie within one zone. This permits such data to be handled (if necessary) within the computer in 4-bit notation, and it simplifies checking on input.

(*j*) In consequence of the requirements above, letters must lie in zones 2 and 3, numbers in zone 1, and functions in zone 0. This arrangement gives the further advantage that the sixth bit can then be regarded as being similar to the Figure Shift/Letter Shift function often associated with 5-track codes, and this particularly assists when adapting equipment originally designed for 5-track working, or perhaps for transmitting this code over 5-track telegraph circuits.

(*k*) Facilities are required for suppression of non-significant (left-hand) zeros; when printing, such zeros may need to be replaced by Space or by a distinctive symbol, for example a hyphen; the facility also has to be provided for easily dealing with suppressed zeros within the computer, for example with radix-conversion instructions or for 4-bit arithmetic. The particular consequence of this requirement is that the four least-significant bits of Space (and also preferably of the special printing symbol) should be the same as those for zero, so that these characters—which are arithmetically similar—may more easily be dealt with, either by program or by special equipment. (The objection which is commonly held to an all-blank character does not apply in the case of a 7-track tape code, nor to the 6-bit character when it is inside the computer system.)

(*l*) The great bulk of information which has to be stored and processed within the computer should all be in a single case or shift; not only does this dispense with the shift-change character, but it also means that it is unnecessary to know the shift condition at any stage of the processing. To conform with established teleprinter and punched-card practice, numbers and capital letters should thus be in the same shift; however, in certain circumstances, e.g. for modern German practice, the numbers and lower-case letters could be in this "normal" shift.

Code for Punched Tape

We can now consider a code for punched tape. It is most desirable that this should follow the computer code, and it is also necessary to add certain facilities which are needed for the proper use of punched tape, e.g. functions to control printers, and means to cope with operator's mistakes. The basic code thus obtained is set out in Table 1, and may be used in this form inside the computer; particular points are discussed in the following paragraphs.

(*a*) The Escape character is a most important innovation due to Bemer (1960). It is used to indicate that the next *single* character has a special meaning i.e. "escaped" out of this code. One use is that the next character should be treated as a function, e.g. "reverse tape"; or as a warning character, e.g. "start block," or "start sub-item." Another application is that the next character means "shift into another case or code and stay in it," i.e. it provides a locking shift. Thus it may be used to escape from this code into another, and hence obtain compatibility between many tape codes; it is only necessary that all such codes should adopt the proposed value 62 (or its corresponding configuration of holes in tape) for Escape, and that it should be used for nothing else. Fortunately, few existing codes use this value for anything important, so there is a prospect of achieving this compatibility, even retrospectively. It also offers expansion for future codes.

(*b*) There are certain important existing machines, e.g. Flexowriters, which necessitate two-shift working with this scheme. It would be undesirable to insist on punching pairs of characters for each change of shift (which the Escape technique would require), so ordinary shift characters (6) and (7) have been provided. Shift Out means that all following characters are to be interpreted as "out" of the set of symbols of Table 1 (e.g. as lower case), until a Shift In is reached which will bring the system back "into" this set of symbols (e.g. upper case).

(*c*) Runout, used for leaders and trailers, etc., is the same as the "normal" shift, so that equipment

Table 1

The Basic Code for 6-bit Characters

Zone 0		Zone 1		Zone 2		Zone 3	
Value		Value		Value		Value	
0	Space	16	0	32	Supp. zero	48	P
1	Spare function	17	1	33	A	49	Q
2	Newline	18	2	34	B	50	R
3	Paper Throw	19	3	35	C	51	S
4	Tabulate	20	4	36	D	52	T
5	Backspace	21	5	37	E	53	U
6	Shift Out	22	6	38	F	54	V
7	Shift In & Runout	23	7	39	G	55	W
8	(	24	8	40	H	56	X
9	)	25	9	41	I	57	Y
10	% or Spare	26	10	42	J	58	Z
11	£	27	11	43	K	59	
12	? or Spare	28	½	44	L	60	
13	&	29	+	45	M	61	
14	*	30	—	46	N	62	Escape ◇
15	/	31	.	47	O	63	Erase ▨

Table 2

Variants of the code realized on Flexowriters used with Orion and Atlas; each has 87 printing symbols

Zone 0			Zone 1			Zone 2			Zone 3		
Value	Upper-case	Lower-case	Value	Upper-case	Lower-case	Value	Upper-case	Lower-case	Value	Upper-case	Lower-case
0	Space	—	16	0	′	32	(Suppressed zero)		48	P	p
1			17	1	[or ¼	33	A	a	49	Q	q
2	Newline	—	18	2	] or ″	34	B	b	50	R	r
3	Paper Throw	—	19	3	< or ¾	35	C	c	51	S	s
4	Tabulate	—	20	4	> or @	36	D	d	52	T	t
5	Backspace	—	21	5	=	37	E	e	53	U	u
6	Lower-case shift	—	22	6	—	38	F	f	54	V	v
7	Upper-case shift & Runout		23	7	| or spare	39	G	g	55	W	w
8			24	8	(	40	H	h	56	X	x
9			25	9	)	41	I	i	57	Y	y
10			26	10 or α	% or $^{-1}$	42	J	j	58	Z	z
11			27	11 or β	£ or π	43	K	k	59		
12	Stop	—	28	½	?	44	L	l	60		
13	Punch On	—	29	+	&	45	M	m	61		
14	Punch Off	—	30	—	*	46	N	n	62	(Escape)	—
15	/	:	31	.	,	47	O	o	63	Erase ▨	—

starts in a known condition; its code is chosen to permit titles to be written on the unpunched part of the paper tape.

(*d*) Newline (2) is a combined carriage-return and line-feed function. In some machines this character would give carriage-return alone.

(*e*) Paper Throw (3) might alternatively give line-feed alone.

(*f*) To help deal with operator's mistakes an Ignore Fault convention is proposed, using Escape. It would apply only where data are being punched in blocks. If a serious mistake is found (i.e. too bad to warrant overpunching with Erase), Ignore Fault would be punched, followed by correct data from the start of the block. On input to the computer the input routine would ignore the faulty block. This corresponds to removing a faulty punched card from a pack. The proposed convention for Ignore Fault is Escape, X, Newline, which will give on a printout a truncated line with a cross.

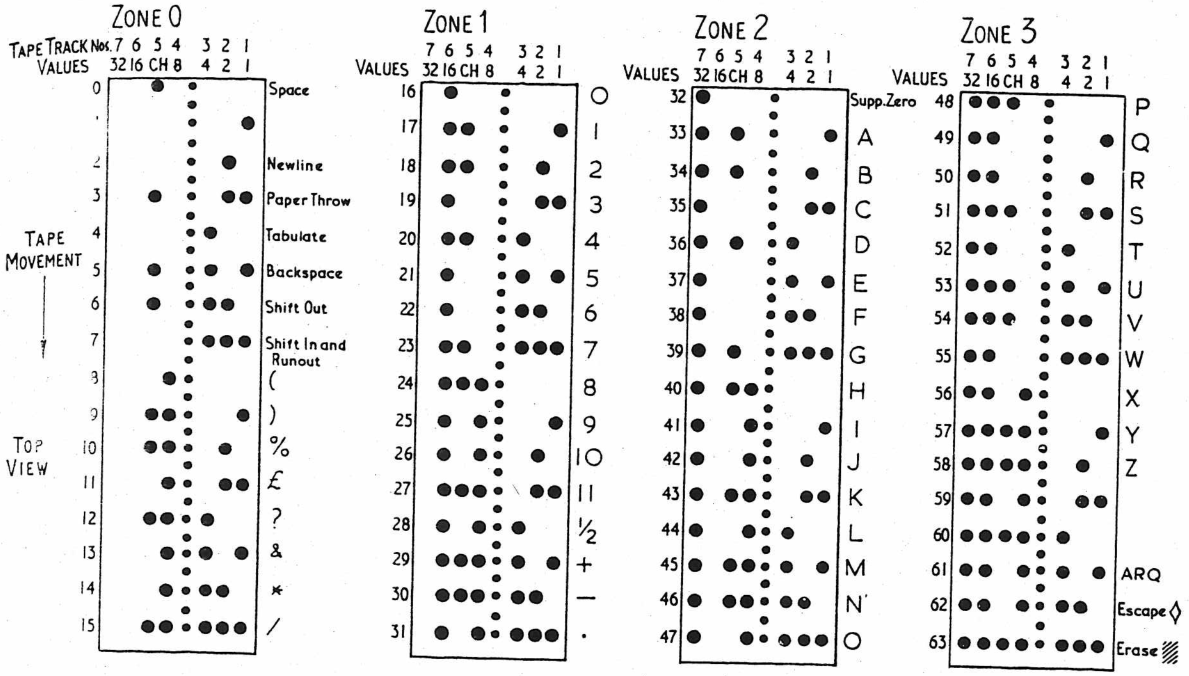

Fig. 1.—The basic code arranged on 7-track punched tape, with a parity check

Fig. 1 shows how the basic 6-bit code may be laid out on 7-track tape, with the extra track used for a parity check. The fifth track is used for this, so that any special circuits to deal with it may be commoned for 5-, 7- or 8-track tapes. In 7-track tape, odd-parity is used (but 8-track even-parity) which permits the use of the all-holes character for Erase—to overpunch any mistake.

Choice of Special Symbols

It is necessary to achieve some reconciliation between the request sometimes voiced for a nearly unlimited number of special symbols and the restricted number of code-combinations available. As a first criterion, it is probably helpful to consider those symbols which are most likely to arise in data, and those which may be involved in the processing within the computer (e.g. for sorting or computation); it is helpful for these to be in the same shift as letters and numbers. The wider range of symbols, on the other hand, usually relate to programs or printing of special documents; the coded characters may be tackled by special program-input or output-printing routines and, at most, usually need to be merely stored within the computer.

It is felt that there is sufficient justification to include the following symbols in the basic code table.

.	Decimal point, sterling separator, full stop.
—	Negative quantity, hyphen.
+	Plus.
/	Separating symbol in part numbers, etc.
10 11	Sterling, dates.
£	Sterling.
( ) &	Used in company names.
? *	No alternative forms, used to signify exceptions.

Accordingly, in Table 1 the symbols . — + 10 and 11 are placed in the numerical zone, / is placed just before the numbers, and the other essential symbols are placed in zone 0.

It is often the case that individual users will require alternative special symbols. Their needs can be met, and the advantages of compatibility of programs and equipment retained, by following the general rules:

(*a*) that any symbol shown in one place in the table should not be moved to another;

(*b*) that any symbol not wanted may be replaced by another not already shown. Thus, for example, £ might be replaced by \$ or Kr; ½ replaced by 12 for December; + replaced by 13 for the last 4-weekly accounting period, or by Db; — replaced by Cr; etc.

More special symbols can be obtained with machines which have upper-case and lower-case working. Table 2 shows such an arrangement, being variants of the code used with Flexowriters on Orion and Atlas, and Fig. 2 shows the keyboard. The total of 87 printing symbols include upper- and lower-case letters, and those used for

Table 3—Possible Code for 3-shift Typewriter, with 130 Printing Symbols

Zone 0				Zone 1				Zone 2				Zone 3			
Value	Upper-case	Lower-case +½	Symbol case +64	Value	Upper-case	Lower-case +½	Symbol case +64	Value	Upper-case	Lower-case +½	Symbol case +64	Value	Upper-case	Lower-case +½	Symbol case +64
0	Space			16	0	′	$_0$	32	Suppressed zero			48	P	p	Spare
1	½-line back	½-line feed		17	1	[	$_1$	33	A	a	α	49	Q	q	Spare
2	Newline			18	2	]	$_2$	34	B	b	β	50	R	r	Spare
3	Paper Throw			19	3	<	$_3$	35	C	c	γ	51	S	s	Spare
4	Tabulate			20	4	>	$_4$	36	D	d	δ	52	T	t	Spare
5	Backspace			21	5	=	$_5$	37	E	e	ε	53	U	u	Spare
6	Symbol case shift			22	6	—	$_6$	38	F	f	Spare	54	V	v	Spare
7	Upper- and lower-case shift & Runout			23	7	|	$_7$	39	G	g	Spare	55	W	w	Spare
8		(		24	8		$_8$	40	H	h	Spare	56	X	x	Spare
9		)		25	9		$_9$	41	I	i	Spare	57	Y	y	Spare
10		%		26	10		$^{-1}$	42	J	j	Spare	58	Z	z	Spare
11		£		27	11		π	43	K	k	Spare	59			
12		?		28	½		⊃	44	L	l	Spare	60			
13		&		29	+		∧	45	M	m	Spare	61			
14		*		30	—		¬	46	N	n	Spare	62	Escape		
15	/	:	;	31	.	,	∨	47	O	o	Spare	63	Erase ▨		

Table 4—Possible extension of the Coding Scheme to give over 200 Printing Symbols; (empty places are spare)

Zone 0					Zone 1					Zone 2					Zone 3				
	Normal Shift		Symbol Shift Value +64			Normal Shift		Symbol Shift Value +64			Normal Shift		Symbol Shift Value +64			Normal Shift		Symbol Shift Value +64	
Value	Upper-case	Lower-case +½	Upper-case	Lower-case +½	Value	Upper-case	Lower-case +½	Upper-case	Lower-case +½	Value	Upper-case	Lower-case +½	Upper-case	Lower-case +½	Value	Upper-case	Lower-case +½	Upper-case	Lower-case +½
0	Space				16	0	′	$_0$	° (deg.)	32	Supp. zero	~ (hyphen)			48	P	p		
1	½-line back	½-line feed			17	1	[	$_1$	{	33	A	a	α		49	Q	q		
2	Newline				18	2	]	$_2$	}	34	B	b	β		50	R	r		
3	Paper Throw				19	3	<	$_3$	⩽	35	C	c	γ		51	S	s		
4	Tabulate				20	4	>	$_4$	⩾	36	D	d	δ		52	T	t		
5	Backspace	Backline			21	5	=	$_5$	≠	37	E	e	ε		53	U	u		
6	Symbol shift				22	6	—	$_6$	≡	38	F	f			54	V	v		
7	Normal shift & Runout				23	7	|	$_7$	||	39	G	g			55	W	w		
8	(	“	Spare function		24	8	⟨	$_8$	←	40	H	h			56	X	x		
9	)	”			25	9	⟩	$_9$	→	41	I	i			57	Y	y		
10	%	@			26	10	base 10	$^{-1}$	Spare	42	J	j			58	Z	z		
11	£	$			27	11	√	π	Spare	43	K	k			59	Ȧ	ȧ		
12	?	!			28	½	12	⊃	∀	44	L	l			60	Ä	ä		
13	&	Db			29	+	±	∧	↑	45	M	m			61	Ö	ö		
14	*	Gr	Spare function		30	[illegible]	×	[illegible]	↓	46	N	n			62	Escape			

the commercial and technical Autocodes. In addition, a further range of composite symbols may be built up by using the Backspace facility. Thus, for example, less-than-or-equal can be made from less-than and underline, and will look adequate on the printout; the corresponding triplet of characters on tape will be interpreted by the Autocode program input routine as $\leqslant$. The following symbols may be obtained in this manner (some will have more than three characters on tape):

$\leqslant$ $\geqslant$ [illegible] - — — $\neq$ $\equiv$ $\not\geqslant$ $\pm$; ! θ ϕ ψ and, for example, $\underline{6}$ to mean a subscript number.

Embodiment in Existing Equipment

It has been felt most important that this code, or some simple variant of it, should be realizable on a fairly wide range of existing punched tape machines: it is perhaps not too cynical to say that it might take five years for new and idealized machines to become available—to be specified, designed, developed, have the bugs discovered and removed, and go into quantity production—all at an economical price. This code is planned for the "next generation" of computers, not only for the next-but-one.

Such punched tape equipment has to be provided for the following classes of work:

(a) Punching and checking data tapes, primarily for commercial work, preferably also with printing out.
(b) Punching data tapes as a by-product of the normal use of office machines.
(c) Punching and printing out program tapes.
(d) Printing documents, especially those for management or for other commercial applications, necessitating a full range of symbols.

The first class of existing machines to be considered is typewriters, the Flexowriter being an example. These usually have 44 keys and printing hammers, together with other function or control keys, and 2-shift working.

The restriction of this keyboard may be overcome, more or less, by the following artifice. The special symbols which have values 8 to 14 in Table 1 may be placed in the lower-case position of the keys for symbols with values 24 to 30 (this has determined the arrangement of these special symbols, so that they "pair up" sensibly on these keys). The coding for these 7 special symbols may then be dealt with in either of two ways:

(a) By coding them in zone 1, as shown in Table 2. The computer input routine, following a lower-case shift character, will have to identify these symbols and "transfer" them from zone 1 to zone 0, by turning the fifth bit into 0. And conversely on output.
(b) By coding them in lower-case of zone 0, as shown in Table 3. This requires the tape machine, when in lower-case, to inhibit punching in track 6 for this group of keys (and to "invert" the parity punching). These symbols will then be coded as in Table 1, but the tape will carry spurious shift characters. And conversely on printing.

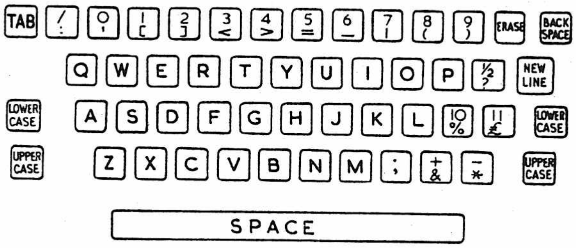
TAB / : 0 ' 1 [2] 3 < 4 > 5 = 6 _ 7 | 8 (9) ERASE BACK SPACE
Q W E R T Y U I O P ½ ? NEW LINE
LOWER CASE A S D F G H J K L 10 % 11 £ LOWER CASE
UPPER CASE Z X C V B N M ; + & − * UPPER CASE
SPACE

Fig. 2.—Keyboard of Flexowriters for Orion, primarily for program preparation

The second class of existing machines is the teleprinter and associated machines. The Creed model 75 teleprinter may be adapted to print directly in the basic code of Table 1 (strictly, it works in the usual figure-shift/letter-shift manner, but the setting of the shift takes place at an early stage in each operating cycle and may be determined by the sixth bit of each 6-bit character).

A large proportion of commercial data tapes are currently produced on keyboard perforators and verifiers. 7-track versions of these could use the keyboards of Fig. 3. The 63 keys offer the attractive feature of normal typewriter layout for alphabet, and single-handed keying for numerical data—which explains the positioning at the right-hand side of all keyboards of the important symbols used with such data.

It is visualized that many British computer installations would have both the typewriter class of machine and also the simpler data-punching machines. It is considered most important that compatible tapes should be produced. This can be achieved by introducing a selective keyboard lock in the simple machines, which is actuated by keys called "lower-case shift" and "upper-case shift"; these keys only work the lock and punch tape, they do nothing like a real shift operation. Thus the operator of such equipment, when wishing to punch any symbol which has to be in lower-case in a typewriter-tape, will be forced to introduce the appropriate shift characters.

Turning to the varied class of office equipment—adding machines, accounting machines, cash registers, automatic data-transcribers, etc.—to which tape punches may be added, as far as is known 7-track versions are available and no difficulties result from using this code.

The basic code of Table 1 is suitable for use with the Rank Xeronic printer, including its controlling functions;

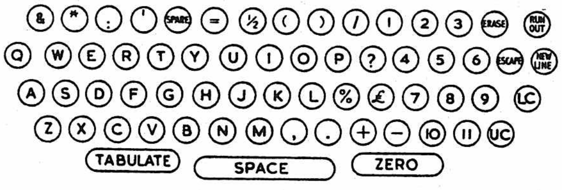
& * : ' SPARE = ½ ( ) / 1 2 3 ERASE RUN OUT
Q W E R T Y U I O P ? 4 5 6 ESCAPE NEW LINE
A S D F G H J K L % £ 7 8 9 LC
Z X C V B N M , . + − 10 11 UC
TABULATE SPACE ZERO

Fig. 3.—Keyboard for simple tape punch and verifier

if required, upper- and lower-case working may be obtained. It is also suitable for the newer line-at-a-time printers such as the I.C.T. 660 class, the IBM 1403, and the Bull 300. Basically, these accept 6-bit characters and do not depend on the 4-zone mode of working of earlier tabulators and printers.

Extensions for Future Work

While the scheme so far described will probably be adequate for the immediate future, it is nevertheless desirable to consider, however tentatively, possible extensions in more ambitious directions. This is partly to meet the potential demand for extended character sets—for advanced technical work or for "common languages" such as ALGOL; it is also useful as an exercise to check whether the basic coding scheme is sufficiently sound to permit extension and development.

In general, such extensions are obtained by introducing shift working and/or an extra track on tape. It is considered that the proper procedure is to start with the basic 6-bit code and to expand it in various logical and systematic ways. This process of expansion is felt to be preferable to the alternative, which has several times been suggested, of a maximum set out of which sub-sets are derived.

One important advantage of the proposed approach is that certain functions (and even symbols) can be made available in all cases or shifts; the most important are Space, Erase, Escape, Newline and other printer controls, the Shifts, etc. Experience has shown that, if arranged otherwise, it is a serious inconvenience to have to get into the right shift to use them.

The following extensions have been considered.

(i) *Use of 8th track for Lower-case Shift Working*

The arrangement on tape might be as shown in Fig. 4. Six of the tracks are used for the basic 6-bit code, another is used for the check (even-parity to permit Erase), and a hole in the 8th track is used to mean lower-case.

The effect of making a hole in the 8th track contribute a value $\frac{1}{2}$ within the computer is that lower-case and upper-case letters are interleaved in value. If sorted in the ordinary way, capital letters will come out first and precede lower-case letters, which seems to be the most usual requirement—at least it will deal correctly with names like Lloyd, for example. Alternatively, in applications where there is no distinction between upper- and lower-case letters as far as the computer processing is concerned, the least-significant digit can be ignored and all alphabetic data will be dealt with properly.

With this arrangement, the shift characters (6 and 7) in Table 1 are not required. Inside the computer, 7 bits would ordinarily be needed for each character; in practice an 8-bit system would probably be used, because it simplifies addressing and allows a check or marker bit.

The coding permits a total of 103 printing symbols. These could be obtained on a typewriter class of machine that was provided with 8 more printing hammers and keys than is now standard.

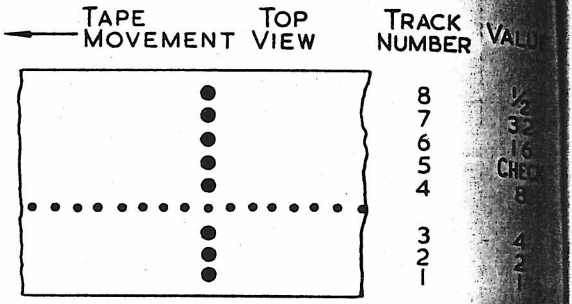

Fig. 4.—Layout of tracks on 8-track tape

(ii) 3-*shift Typewriter*

Some typewriters are made with 3-shift working; each printing hammer has 3 symbols and the type basket may be moved to 3 positions. Assuming a normal typewriter keyboard, and calling the shifts upper-case, lower-case and symbol-case, we can obtain the arrangement of Table 3, which permits a total of 130 printing symbols. This is suggested primarily for program preparation, or printing special-purpose documents of a technical nature; it probably has sufficient logical symbols for the basic ALGOL work as described by Woodger (1960).

The upper and lower cases are arranged as in the 2-shift typewriter, and suffix numbers and 33 other symbols are available in the symbol case; in this, and all the other systems, the symbols are arranged to minimize the number of case-shift operations required for typical work. And pairs of symbols, e.g. [and] are placed on adjacent keys, instead of in different shifts on the same key; this should minimize keying errors.

Such a typewriter could be used with 8-track punched tape and 8-bit computer characters. Lower-case would correspond to a hole in the 8th track and would contribute value $\frac{1}{2}$ in the computer. Symbol-case could be obtained on tape with the shift characters, and perhaps also in this way in the computer; it would, however, be preferable to use the most-significant bit (value 64) of the computer character for this, the input routine making the necessary conversion. The check bit would be dropped within the computer. The central 6 bits within each 8-bit computer character are in the basic code.

(iii) 8-*track System with* 2 *Shifts*

The logical extension of the preceding ideas gives a system using 8-track punched tape with 2 shifts; these shifts might be called *normal shift* and *symbol shift* and within each there might be upper-case and lower-case. As in (ii) above, lower-case would correspond to a hole in the 8th track on tape, and would contribute value $\frac{1}{2}$ in the computer; symbol shift could be obtained with shift characters on tape, and would probably contribute value 64 to the 8-bit character in the computer.

No machine is known which is capable of utilizing such a system, but one possible arrangement of the code is shown in Table 4. This provides for:

(*a*) Upper- and lower-case of normal shift as in Table 1, and the ordinary 2-shift system (it is apparent that any machine would require about 64 keys).
(*b*) A wide range of functions in zone 0.
(*c*) Commercial special symbols in zone 0.
(*d*) Numbers, numerical symbols and the commoner Autocode program symbols in normal shift of zone 1.
(*e*) Upper-case of symbol shift the same as symbol case of the 3-shift typewriter.
(*f*) Lower-case of symbol shift contains the symbols which were otherwise built up by using Backspace.
(*g*) A wide range of other special symbols, including many spares; those shown follow Bemer and Buchholz (1960), but there is much scope for variation.
(*h*) Scandinavian letters, French or Spanish accents.
(*i*) A total of over 200 printing symbols.

(iv) *Compatible Punched-card Code*

The possibility ought not to be entirely ruled out that codes for punched cards, different from the present codes, might come into use. The main aims might be to permit an extended range of characters or to use a code more easily accepted and processed by electronic data-processing systems.

It would, of course, be straightforward to arrange that holes punched in the rows of the cards corresponded in some way to those in tracks on tape. The coding scheme described would be suitable for this.

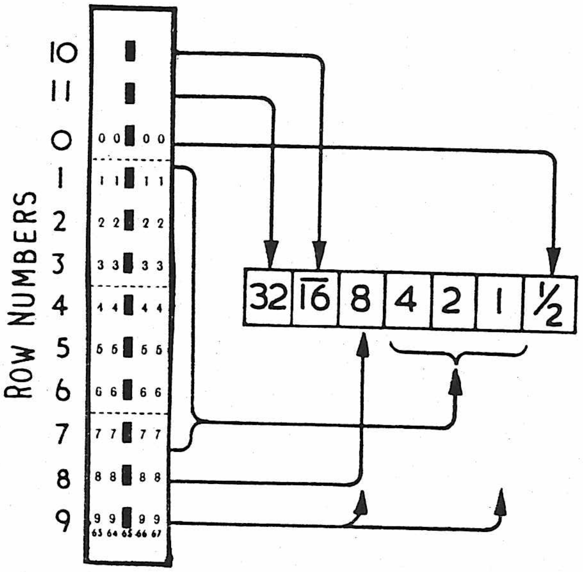

Fig. 5.—Possible relation between punching in a card and character in computer

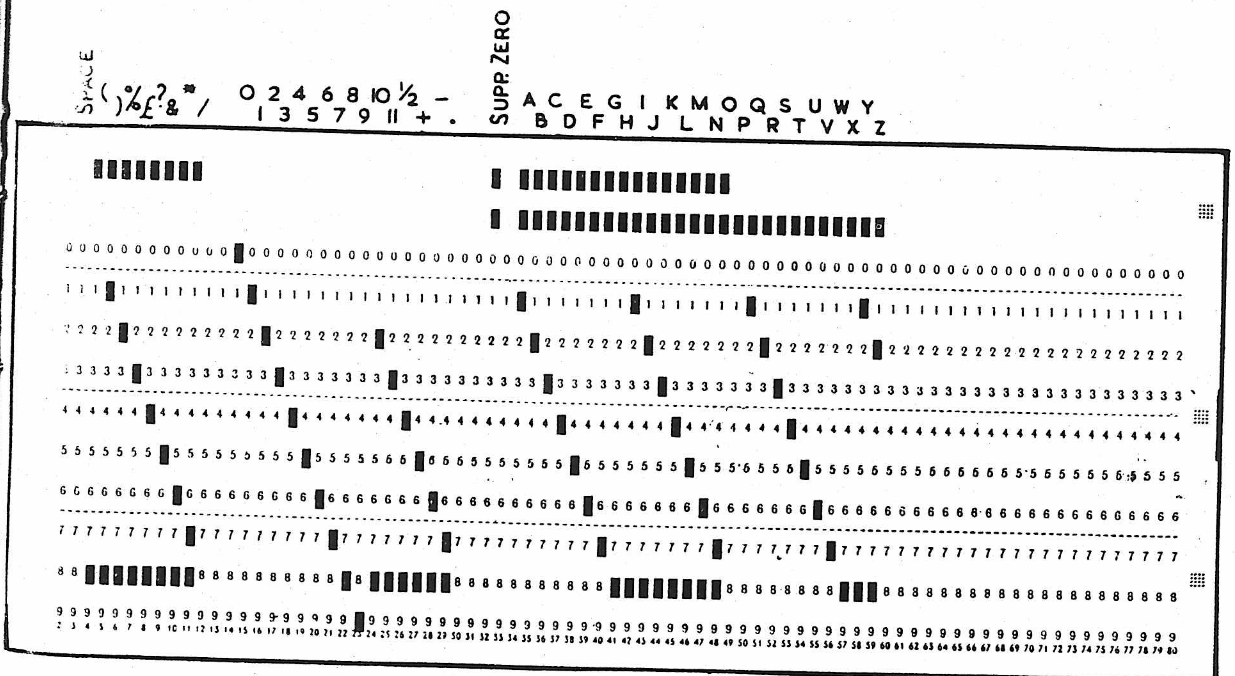

Fig. 6.—A possible application of the basic code to punched cards

However, there might be some attraction in devising a more sophisticated arrangement which would permit the normal punching for numbers 0 to 9 to be retained; this would allow numerical punching to be easily interpreted visually—one of the special advantages of punched cards—and might allow some existing cards or equipment to be used.

One way of achieving this with the proposed coding scheme is to arrange the relationship between holes in the rows of the card and "ones" in the character in the computer as shown in Fig. 5.

The following rules must then be introduced for interpreting the punching in any column of the card.

(*a*) If there is any hole in a column, then "invert" the meaning of row-10, i.e. let "no-hole" contribute value 16 to the computer character, and let a hole contribute 0.

(*b*) If there is no hole in rows 1 to 9, then ignore any hole in row 0.

The effect of rule (*a*) is to give the normal punching for space (blank column) and for numbers 1–9; the effect of rule (*b*) is to give normal punching for zero.

The resulting card punching for the symbols of Table is shown in Fig. 6. In addition, row 0 is available to be used for a parity check, or for lower-case shift (except lower-case of zero) corresponding to the arrangement of (i) above, with over 100 printing symbols. If required, row 9 could be used for the symbol shift of the arrangements of (ii) and (iii) (although the number 9 would then have to be punched as row 8 and row 1).

Acknowledgements

This scheme, especially the computer code and basic code of Table 1, is the combined work of many colleagues, particularly Mr. G. E. Felton, Dr. S. Gill, Mr. I. V. Idelson, and Dr. C. H. Lindsey. Valuable contributions have been made by Mr. R. A Brooker, Mr. R. W. Bemer and by members of the Punched Tape Coding Committees of the British Standards Institution and the Electronic Engineering Association. The paper is published with the permission of Ferranti Ltd.

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Correspondence

The Editor,
The Computer Journal.

Dear Sir,

Re: The article "Prime Number Coding for Information Retrieval," Computer Journal, Vol. 3, April 1960, p. 21.

I wish to make extant the fact that I have written a program which thrives on a technique remarkably similar to the one which the article calls, "so far as we know novel."

My program searches the Mass Memory of the Mobidic "B" Computer, using Goldbach Pairs (i.e. pairs of primes which in sum equal composite numbers). Initially, the program computes these pairs, that is to say, tests each composite number and determines all its pairs.

I am happy that others discovered and are using the technique, and indeed, that some use for prime numbers exists.

Yours respectfully,
Moses M. Berlin

c/o Sylvania Electronic Systems,
Needham 94,
Mass., U.S.A.

20 December, 1960.

X3-2 Sub-Committee
on
Character Sets & Data Formats
of the
American Standards Association
X3 Sectional Committee
Sponsored by
O.E.M.I.

January 16, 1961

MINUTES

#4 MEETING OF JANUARY 11th and 12th

Membership

MEMBERS

Present:	Not Present:
John Aurwaerter - Teletype Corporation	John H. Craig - AT&T Co.
Leon Bloom - NCR	Robert W. Green - Standard Register Co.
Theodore H. Bonn - Remington Rand	D. Hiz - Rem. Rand. Univac
L. L. Griffin - Navy Department	W. S. Nivison - Recordak
H. Kleinberg - RCA	Lawrence J. Schoenberg - Monroe Calculating Machine
I. C. Liggett - IBM	H. Spielman - RCA
C. E. Macon - Burroughs Corporation	B. B. Weber - Addressograph-Multigraph Corp.
E. Clifford Olofson - Royal McBee Corp.	
Roy W. Reach - Minneapolis Honeywell	Guest:
H. J. Smith, Jr. - IBM	Ray Young - Bell Telephone Laboratories
H. Tholstrup - Frieden Incorporated	
Allen L. Whitman - Bell Telephone Laboratories	

Mr. Green has tendered his resignation from the committee. His work on the other X3 activity does not permit sufficient time to include X3-2.

1/013
HAWM

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2. Membership and Participation Rules

2.1 Membership

The following rules for membership were constituted and approved by unanimous vote.

2.1.1 The prospective member must submit a resume outlining his qualifications for membership on this committee.

2.1.2 Each member must be willing to spend from one-third to one-fifth of his time on the work of the committee. It was noted that in the case of members representing corporations or organizations, that this time might be supplied by others in that organization in support of the members work.

2.2 Attendance

It is expected that members make every reasonable effort to attend meetings. Two consecutive unexcused absences will be sufficient to cause an individual's membership to be revoked. Excused absences consist of submitting a written statement prior to the meeting that a member will not be able to attend. Such a statement should include a brief statement of reason.

2.2.1 One and only one voting member will be accepted from any particular organization or corporation.

2.2.2 Each member is to specify an alternate to occupy his "chair" in his absence. Appropriate procedures are to be worked between member and alternate to provide for continuity.

2.3 Participation

Observers are welcome but should preferably notify the chairman of their anticipated presence prior to the meeting. Observers will be permitted to speak only upon request by the committee.

3. Documents Distributed

3.1 Revised agenda for the meeting

3.2 "Do It By Numbers - Digital Shorthand" by R.W. Beamer

3.3 Copies of the complete Grems-Mullery report entitled "Analysis of the ASA X3 Project"

NOTE: This report was supplied for information only.

3.4 Mr. Whitman supplied copies of "Proposed Six Unit Code for Teletypewriter and other Data Communication to Operate with 4 Row Electric Typewriter Keyboard - December 19, 1960" to addenda were supplied:

Table 1 "Six Unit Code Chart"

Table 2 "Character Difference Between Fieldata and Bell System Proposal"

4. Attention was called to a semantical problem on Table 1 of the Bell System proposal. It was noted that the term "reflected" in the footnote should read "order of digits has been reversed".

5. Correction to "Scope and Objectives"

Attention was called to a transcription error. The word "media" in item 2 under Scope and item 7 under Objectives should be replaced by the word "medium".

6. Revision to Agenda

Item 3.4 was moved to item 3.1.4

It was decided that the evening meeting would be an informal discussion amongst those members who wished to attend.

7. Engineering and Scientific Symbols

In additions to his written report, Mr. Reach indicated that the engineering and scientific symbols to be included in a 64 character set would be covered under the report on mathematical symbols. He further noted that there are several sub-sets which should be included in an expanded character array (for example, the Greek alphabet).

8. CABOL and ALGOL

Mr. Bonn indicated that the 51 characters included in the CABOL chart were obtained from the Department of Defense report on the subject. Mr. Bonn briefly reviewed the 116 characters in the ALGOL set. He further indicated that he did not know of the graphics to be used to identify the verb symbology. He will be investigating this matter and report at the next meeting.

Mr. Bonn stated that his investigation indicated that both languages are expected to grow. There was some discussion of the implications of this point on the activity of X3-2.

Mathematical Symbols

Mr. Smith quickly reviewed his paper on the subject. There was some discussion as to the desirability of including two plus graphics and two minus graphics for the purpose of distinguishing between magnitude symbols and operators. A similar discussion was held with regard to the identification of a radix indicator distinguishable from the period. The decision was tabled, pending further clarification of the philosophy to be employed in stipulating the 64 character set.

It was moved and generally accepted, that the magnitude plus and minus graphic and the radix indicator be included with the numeric sub-set of the 64 character set.

10. Relationship with EIA

It was reported that the EIA had held a meeting in December at which time it recognized officially the X3-2 activities. Mr. Henry Tholstrup was appointed by EIA as the liaison man from EIA to X3-2.

11. Communications Industry

The problem of the interface between the X3 activities and those associated with the communications industries was identified. Mr. Liggett will check on this problem and report at the next meeting.

12. EIA Activities

It was generally agreed that the EIA would place their emphasis on the problem of defining the physical parameters for the various media. Mr. Tholstrup will supply a statement of scope and status for the various EIA activities related to X3-2 along with such standards as have been identified. He will try to circulate this information prior to the next meeting. Specific items are punched cards, punched paper tape, and mag tape.

13. Meetings

It was identified that two day meetings are most beneficial for all concerned. The tentative schedule for meetings in the next several months was agreed upon and is:

February 8th and 9th
March 9th and 10th
April 12th and 13th
May 10th and 11th
June 7th and 8th

Of the above meetings, all are tentatively scheduled for New York with the exception of the March meeting, which is tentatively scheduled to be held in the Los Angeles area. The feasibility of holding the March meeting in California will be studied and a decision reached at the February meeting.

January 16, 1961

Mr. Aurwaerter presented an excellent talk on the technical aspects of data transmission on teletype systems and its implications with respect to character sets. Many of the points identified in this talk were discussed at some length.

15. Three working charts were drawn up on the blackboard and completed to some extent by the committee. Reasonable facsimiles (I hope) of these charts are attached. Specifically they are:

A. Control codes versus device

B. Special symbols versus industry

C. Character desired by functional category

16. The following "homework" was assigned each member:

A. Complete the chart of control symbols versus media

B. Identify his proposal for a 64 character set

C. Determine the basic collating sequence or order for this set. That is, the order of the alpha sub-set with respect to the numeric sub-set with respect to the special character sub-set or sub-sets.

C E Macon

C.E. Macon
Secretary

CEM:aks

CEM
1/13/61

Chart B

Special Symbols vs "Industry"

	Int	Business	Com	English	Scientific	D.P.			
[illegible]		✓	✓	✓	✓	✓			
[illegible]		✓	✓	✓		✓			
[illegible]		✓	✓	✓	✓				
:		✓		✓	✓	✓			
?		✓	✓	✓					
!			✓	✓	✓				
				✓					
&		✓	✓	✓		✓			
+		✓			✓	✓			
$		✓	✓	✓					
=					✓	✓			
@		✓			✓				
CR		✓							
(		✓							
<					✓	✓			
>					✓	✓			
[ ]					✓	✓			
|					✓				
↑ ↓					✓				

Key Board	Bulk Storage	Line Printer	Page Printer	Paper Tape	Mag Tape	Cards	Control Codes vs Device
							Null
						✓	+
						✓	—
			✓				Upper Case
			✓				Lower Case
				✓			Rubout (All Holes)
							WRU
			✓	✓			Idle (No Holes)
			✓	✓			C.R.
		✓	✓	✓			Line Feed
			✓				Bell
	✓		✓	✓		✓	Stop
	✓		✓				Start
						✓	Field
						✓	Sub Record
				✓		✓	Record
							Group
	✓			✓	✓	✓	Block
	✓				✓		Tape Mark
	✓				✓		File
	✓						Library
		✓	✓				Color Shift
	✓	✓	✓		✓	✓	Skip
			✓	✓			Tab
			✓				Back Space
		✓	✓				Form Feed

Chart A
CEM 1/16/61

CEM
1/17/61

Chart C
Characters Desired by Functional Category

Item	No. Ch.	Remarks
1. Alpha	26	A → Z
2. Numeric	13	0 → 9 + − .
3. Space	1	blank - as between words on printed copy
4. Correspondence		. , ( ) - / : ; ' " { ? ! underline
5. Business		& + $ = * % # @ C_R { ¢
6. Engr - Science		{ Large Sets Handled as special escapes
7. Algol		{ Possibility of Expansion - Shorthand
8. Cobol		
9 Math - Science		⊕ ¬ ∧ ⓪ | + − × ÷ = ① | < > ② | ∧ ∨ ⊬ ↑ ↓ → ← ≡ ③
		{ [.] ≧ ≦ ⊃ |
10 International		{ Expansion to 33 alpha, 10 & 11 £ s. d special punc. & the Like.
12. Control & Special		{ CR, Line Feed, null, Upper Case, Lower Case Rubout (delete), Stunt (Escape, Special) Who Are You (WRU), Bell, stop, start, shift, tab, Field, sub record, record group, block, tape, file, library.

X3-2

Memorandum

FOR ALL INTERNAL COMPANY CORRESPONDENCE

DATE January 24, 1961

TO W. W. Finke, J. E. Smith

FROM R. W. Reach

SUBJECT X3-2 Committee Meeting
New York, January 11 and 12

COPIES TO:
M. Antman
B. K. Betz
R. Clippinger
C. Dubay
J. Eachus
T. McNamara

A two day meeting of the X3-2 Committee was held in New York on January 11 and 12. One new member, Mr. J. F. Auwaerter, Director of Product Development of Teletype was introduced.

Since the X3-2 Committee is beginning to grow and the issues discussed are becoming more debatable, the following rules were agreed upon:

1) Two consecutive unexcused absences will result in being dropped from membership.

2) There will be but one voting member from each organization.

3) If a member finds that he cannot attend, he should send a "well-informed" alternate who will then have full voting power (Tom McNamara has agreed to act as my alternate).

The matter of cooperation with the EIA Committees doing work similar to that assigned X3-2 was discussed. Mr. Henry Wholstrup is now the "official" liaison between the ASA X3-2 and EIA TR 27.6 Committees. There appears to now be full agreement that the EIA Committees TR 27.6.1, TR 27.6.2, and TR 27.6.3 will continue their work in establishing reasonable proposed standards for the physical properties of the various media (such as physical dimensions, composition, manufacturing processing, testing, etc.), and X3-2 will concentrate its efforts on the coding and usage of the media. When all the work is complete, X3-2 will review the entire set of recommendations established both by its own members and by the EIA Committees, and then send the recommendations on to the main X3 Committee for appropriate action in establishing a final standard.

The remainder of the two-day meeting was spent in discussing the usage of each individual character that could be considered as a member of a standard character set. By previous agreement, a "major usage" subset of 64 characters is desirable; the 64th character would be an "escape" character to allow escaping into other subsets of 63 useful characters, such as a "mathematics subset", "weather symbol

CBI 67/1/1

subset", "control mode subset", etc. There was good agreement on 47 of the 64 characters that should be members of the "major usage" subset. These 47 are:

English Alphabetic Capitals "A-Z"	-26
Numerals "0-9"	10
Radix point and/or period "."	1
Minus Sign and/or hyphen "-"	1
Open and Close parenthesis "()"	2
Slash "/"	1
Asterisk "*"	1
Space or blank	1
Number symbol "#"	1
Comma ","	1
Percent sign "%"	1
Escape code	1
	47

The remaining 17 characters became the subject of considerable debate. Charts were made of 6 categories of requirements - Data Processing, Business, Communications, English Text, Scientific, and Control - with an unsuccessful attempt to add more characters to the "no debate" section. There was considerable pressure from one member in particular, Mr. Auwaerter of Teletype (with his associates from the AT&T system, Messrs. Craig of AT&T and Whitman of Bell Labs), to incorporate all of the Teletype Control signals (22 symbols) as part of the "major usage" subset. There appeared to be some uninformed feeling generated that this was representative of the communication problem.

The members of X3-2 were asked to bring a proposed complete 64 character set to the next meeting - after individual independent study - together with a proposed collating sequence for the characters. My first proposal is attached to this report, and will be circulated within the EDP Division for comments.

Due to the large amount of work facing X3-2 before the summer ISO meeting, and in deference to the California members who must travel so far for the meetings, two-day meetings have been scheduled for the next five months:

Feb. 8 and 9 - New York
March 9 and 10
April 12 and 13
May 10 and 11
June 7 and 8

R. Reach
R. Reach

RWR/ee

January 24, 1961

X3-2

PROPOSED "MAJOR USAGE" SUBSET

OCTAL	CHARACTER	OCTAL	CHARACTER
00	0	40	P
01	1	41	Q
02	2	42	R
03	3	43	S
04	4	44	T
05	5	45	U
06	6	46	V
07	7	47	W
10	8	50	X
11	9	51	Y
12	#	52	Z
13	*	53	& (ampersand)
14	- (minus)	54	$
15	+ (plus)	55	Cr (credit)
16	/ (slant)	56	= equals
17	. (radix pt)	57	@
20	Space	60	(open parenthesis
21	A	61	) close parenthesis
22	B	62	, comma
23	C	63	% per cent
24	D	64	: colon
25	E	65	" quotes
26	F	66	; semicolon
27	G	67	?
30	H	70	Escape
31	I	71	Line Feed
32	J	72	Start
33	K	73	Stop
34	L	74	↑ record mark or superscript
35	M	75	↓ item mark or subscript
36	N	76	Carriage Return
37	O	77	Null

Roy Reach
1/24/61

Jan 25 1961

Routing Slip - Special Projects

Please date and pass on

Antman

Miss Ellis

Alter

Bennett

Cardello

Coburn

Daly

Deerfield Jan 31,

Indicated no interest TEB

Ellis

Feit

Frongillo

Goldman

Goldstein

Harris

[illegible]

Krasnick

Kruj

Loycano

Lukianov

Miles

Montag

Muller

Nackley

Oppenheim

CCR Ramamoorthy Jan 31

no Comment

Schuler

Semionko

Shaughnessy

Wood

Bulletin Board

[illegible]

Return to ANTMAN

File

is will determine EDP
ceptance of a proposed
ustry standard.

CBI 67/1/1

~~[illegible]~~
Roy Reach

No comment. See attached slip. ~~[illegible]~~

Memorandum

FOR ALL INTERNAL COMPANY CORRESPONDENCE

DATE January 25, 1961 COPIES TO:

TO Those Listed

FROM R. W. Reach

SUBJECT Attached - X3-2 Proposed "Major Usage" Subset

This is a Proposed "Major Usage" Character Subset and Collating Sequence. Comments are requested as to suitability for future systems, disregarding the Hollerith Code considerations.

R. W. Reach
R. W. Reach

RWR/ee

cc: [illegible] Antman
B. K. Bets
R. Clippinger
D. Dubay
J. Eachus
T. McNamara

P. Anderson
R. Bender
R. Bloch
B. Colton
K. Gurewitz
E. Dieterich
C. Eldred
H. Ellis
W. Gordon
W. Grey
S. Harper
R. Lawrence
J. Levin
N. Lourie
J. Mekota
H. Schrimpf
I. Wyman
W. D. Woo

CBI 67/1/1

January 24, 1961

X3-2

PROPOSED "MAJOR USAGE" SUBSET

OCTAL	CHARACTER	OCTAL	CHARACTER
00	0	40	P
01	1	41	Q
02	2	42	R
03	3	43	S
04	4	44	T
05	5	45	U
06	6	46	V
07	7	47	W
10	8	50	X
11	9	51	Y
12	#	52	Z
13	*	53	& (ampersand)
14	- (minus)	54	$
15	+ (plus)	55	Cr (credit)
16	/ (slant)	56	= equals
17	. (radix pt)	57	@
20	Space	60	(open parenthesis
21	A	61	) close parenthesis
22	B	62	, comma
23	C	63	% per cent
24	D	64	: colon
25	E	65	" quotes
26	F	66	; semicolon
27	G	67	?
30	H	70	Escape
31	I	71	Line Feed
32	J	72	Start
33	K	73	Stop
34	L	74	↑ record mark or superscript
35	M	75	↓ item mark or subscript
36	N	76	Carriage Return
37	O	77	Null

Roy Reach
1/24/61

NMAH 310/1

MEMORANDUM

The National Cash Register Company

ELECTRONICS DIVISION

To Leon Bloom

From S. Porter

Subject Preliminary Symbol and Code Assignment for a 256 Character Set, and Subsets Thereof.

Date 25 January 1961

Each character is represented by an 8-bit code which is divided into digits thusly: xxw-www-yz. The 16-character set is represented by the 4 w bits. To imbed the 16-character set in the 64-character set, xx = 00 is prefixed. To imbed the 64-character set in the 128-character set, y = 0 is suffixed. To imbed the 128-character set in the 256-character set z = 1 if suffixed.

The following pairs of symbols are normally distinguishable, but could be combined into one character. I recommend that they remain distinct in the 256-character set.

union	∪	352	capital letter	U	701
multiplication	×	161	capital letter	X	731
such that	∍	612	Russian capital letter	Э	762
vertical bar	|	632	lower case letter	l	573
or	∨	353	lower case letter	v	713

The criteria used in setting up the alphabetic section of the 256-character set were

1. The letters of the English alphabet be uniformly spaced at intervals equal a power of 2.

octal ↓

4+6 bit set (y=0; z=1)

y+z bits

	00	01	10	11
00	0	0	1	α
	2	1	3	β
02	4	2	5	γ
	6	3	7	δ
04	8	4	9	ϵ
	0	5	1	ζ
06	2	6	3	η
	4	7	5	θ
10	6	8	7	ι
	8	9	9	κ
12	(	SPACE	+	λ
	)	+	.	μ
14	,	.	a	ν
	b	,	c	ξ
16	d	×	e	ο
	f	–	g	π
20	h	'	i	ρ
	j	#	k	σ
22	l	*	m	τ
	n	$	o	υ
24	p	%	q	ϕ
	r	/	s	χ
26	t	@	u	ψ
	v	?	w	ω
30	x	<	y	⩾
	z	>	∃|	⩽
32	∫	Σ	∀	±
	∄	:	∃	∓
34	≡	=	≢	≠
	∩	&	∪	∨
36	{	(	≈	[
	}	)	!	]

	00	01	10	11
40	┐	↑		
	┌	↓		
42	└	←		
	┘	☞		
44	A̍	A	Â	a
	Б	B	÷	b
46	Г	C	Ç	c
	Ɛ	D	&	d
50	Д	E	Ê	e
	Ж	F	→	f
52	З	G	~	g
	ℵ	H	∞	h
54	İ	I	Î	i
	И	J	Й	j
56	⇒	K	⇏	k
	Л	L	∝	l
60	⇔	M	⇎	m
	Н	N	϶	n
62	″	O	Ô	o
	П	P	|	p
64	⊂	Q	⊇	q
	⊃	R	⊆	r
66	С	S	•	s
	∇	T	У	t
70	U̇	U	Û	u
	Φ	V	;	v
72	∂	W	∴	w
	½	X	Ц	x
74	Ч	Y	Ш	y
	Щ	Z	Ы	z
76	Ъ	£	Э	¬
	Ю	Δ	Я	Ω

umflex (comb. umlaut & circumflex)

Column headings are yz bits. Numbers on the side are xxw – www in octal form.

000(2)042 are superscripts 050(2)302 are subscripts 401(2)433 are control characters

2. The lower case letters be uniformly related to the corresponding upper case letter.
3. There be two sort modes in English:
    a. Lower case letters follow the corresponding upper case letter, viz., A, a, B, b, C, c, etc.
    b. Letters be sorted without regard to case.
4. French, German, and Russian also be sortable order.
5. Characters be sortable without regard to accent in French and German.
6. The digits 0-9 have four contiguous bits in binary coded decimal form.

The list of desirable alphabetic characters started with A À Â Ä a б B b. Other letters also have a large number of variants. These numerous variations (with the above requirements) imply a spacing of 8 units between the capital letters of the English alphabet. This implies that a 64-character subset obtained by truncating the 8-bit code would have 2 unit spacing between the capital English alphabet characters, and therefore only 3 characters beside the numbers could be sorted either before or after all the alphabetic characters. Other characters will be interlaced between the alphabetic characters.

Memo to Leon Bloom

From S. Porter

Subject Preliminary Symbol and Code
Assignment for a 256 Character
Set, and Subsets Thereof.

Date 25 January 1961

Instead of following the above approach I combined symbols. The umflex (´`) is recognizable to the Germans as an umlaut, and to the French as a circumflex. Upon consultation with speakers of French, it appears that, merely to avoid ambiguity, it is not necessary to distinguish between the accents grave and acute or between the circumflex and the dieresis. Indeed, the Bull card code shows no accents at all. I therefore combined these two pairs of accents into the vertical accent (') and the umflex. These combinations allow a 4 unit spacing between the letters of the English alphabet. The following sorting considerations result:

1. English, German and French are sorted ignoring the 2 least significant bits.
2. Russian is sorted using all bits.
3. Putting words which are identical except for accent marks in suitable order is a matter of sort technique as much as of codes. In Russian there is no problem since Ё and Й are separate letters. For the other languages we can

a. Ignore the accent for sorting (as in note 1),

b. Call each character a separate letter and use an 8-bit sort,

c. Have the accent order if, and only if, the words are otherwise identical. For a pocket sort the first pass could be "Is there any character with a zero least significant bit?" (or if one is fussier, do the accent sort one character at a time, thus doubling the number of passes). For a merge sort a more sophisticated compare command is needed, and there will be no time increase.

To allow for sorting Russian it was necessary to insert 5 characters which could otherwise use graphics already required. Slight modifications are imposed on the "duplicates" to allow distinguishing them:

C 461, с 660
H 531, н 610
Y 741, у 672
b 453, ь 760
3 031, з 520

Memo to Leon Bloom

From S. Porter

Subject Preliminary Symbol and Code
Assignment for a 256 Character
Set, and Subsets Thereof.

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Similarly, it is necessary to distinguish between

zero	0	001	capital "O"	O	621
omicron	ο	163	lower case "o"	o	623

The following pairs of characters are transformed into each other by complimenting the

002 bit		001 bit		010 bit		020 bit	
< 301	≥ 303	∫ 320	Σ 321	(120	) 130	∃ 332	∃| 312
> 311	≤ 313	≡ 340	= 341	(361	) 371		
∃ 332	∄ 330	≢ 342	≠ 343	{ 360	} 370		
≡ 340	≢ 342	∩ 350	& 351	[363	] 373		
= 341	≠ 343	∪ 352	∨ 353	∃ 332	∀ 322		
ε 470	∉ 472			± 323	∓ 333		
⇒ 560	⇏ 562			> 311	< 301		
⇔ 600	⇎ 602			≥ 303	≤ 313		
⊂ 640	⊇ 642						
⊃ 650	⊆ 652						
∩ 350	∪ 352						
& 351	∨ 353						

Four common control characters are allowed for in the 64-character set.

↑ is the graphic for $\frac{1}{2}$ line shift up.

↓ is the graphic for $\frac{1}{2}$ line shift down.

← is the graphic for carriage return and line feed.

☞ is the graphic for tab.

These are 401(010)431. Four additional (unassigned) control characters are allowed for in the 128 and 256-character sets, giving a total of 8 control characters, 401(002)433. 402(010)432 are unassigned.

Notes on sub and super scripts

1. The main function of having explicit characters as sub/super scripts is for human readability. They can only be used for one level of sub/super scripting. Quite possibly they do not belong in a 256-character set.
2. In setting up the codes for the sub/super scripts, regularity was the main guide and required an increment of 002 between successive sub/super scripts. In the

(unlikely) event that one wishes to do decimal arithmetic on sub/super scripts it might be desirable to make the superscripts be 000(010)110, and the numeric subscripts be 002(010)112. This will probably simplify adder input logic.

	00	01	10	11	TELE-TYPE	MOST SIG BITS	FIELD ATA
00 0000	0	0	0	α	0	11	0
	1	1	1	β	1		1
	2	2	2	γ	2		2
	3	3	3	δ	3		3
	4	4	4	ε	4		4
	5	5	5	ζ	5		5
	6	6	6	η	6		6
	7	7	7	θ	7		7
	8	8	8	ι	8		8
	9	9	9	κ	9		9
	(	SPACE	(	λ	!		!
	)	.	)	μ	.		.
	+	+	+	ν	+		+
	−	−	−	ξ	−		−
	•	;	;	ο	;		;
	×	X	×	π	RUB OUT		DLE
01 0000		@		ρ	Blank	00	MASTER SPACE
		$		σ	$		$
		*		τ	*		*
		#		υ	#		#
	∩	&	∪	∨	&		&
	∫	Σ	∀	¬	SPACE		SPACE
	Á	A	Â	a	A		A
	Б	B	÷	b	B		B
	Γ	C	Ç	c	C		C
	Ɛ	D	Ȼ	d	D		D
	Д	E	Ê	e	E		E
	Ж	F	→	f	F		F
	З	G	~	g	G		G
	ℵ	H	∞	h	H		H
	í	I	Î	i	I		I
	И	J	Й	j	J		J

allowed for expansion to 32 character foreign alphabet

SWAP (see notes)

	00	01	10	11	TELE-TYPE	MOST SIGNIFICANT BITS	FIELD ATA
10 00 00	⇒	K	⇏	k	K	01	K
	Л	L	∝	l	L		L
	⇔	M	⇎	m	M		M
	Н	N	∋	n	N		N
	£	O	Ö	o	O		O
	П	P	|	p	P		P
	⊂	Q	⊇	q	Q		Q
	⊃	R	⊆	r	R		R
	C	S	•	s	S		S
	∇	T	У	t	T		T
	U̇	U	Ü	u	U		U
	Φ	V	;	v	V		V
	∂	W	∴	w	W		W
	½	X	Ц	x	X		X
	Ч	Y	Ш	y	Y		Y
	Щ	Z	Ъ	z	Z		Z
11 00 00	Ы	:	Ь	φ	:	10	:
	Э	?	Ю	χ	?		?
	∃|	'	Я	ψ	'		'
	∃	/	∄	ω	/		/
	≡	=	≢	≠	=		=
	{	(	≈	[	(		(
	}	)	!	]	)		)
	i	%	j	⊕	%		%
	k	<	l	≥	BELL		<
	m	>	n	≤	WRU		>
		"		°>	"		"
	⌉	↑		±	UC		UC
	⌈	↓		∓	LC		LC
	L	←			CR		CR
	⌋	☞			LF		LF
	\	Δ		Ω	SPEC		SPEC.

For TELETYPE: CHANGE TWO MOST SIGNIFICANT BITS: 00→11, 01→00, 10→01, 11→10

SUBSTITUTE Substitute blank for @, SPACE for Σ,

NMAH 310/1

Leon Bloom
Nat. Cash Reg.
2/8/61

X3-2 Sub-Committee
on
Character Sets & Data Formats
of the
American Standards Association
X3 Sectional Committee
Sponsored by
O.E.M.I.

February 14, 1961

MINUTES

#5 MEETING OF FEBRUARY 9th and 10th

Membership

MEMBERS

Present:	Not Present:
John Auwaerter - Teletype Corporation	H. Klainberg - RCA
Leon Bloom - NCR	Lawrence J. Schoenberg - Monroe Calculating Machine
Theodore H. Bonn - Remington Rand	B. B. Weber - Addressograph-Multigraph Corporation
L. L. Griffin - Navy Department	
I. C. Liggett - IBM	
C. E. Macon - Burroughs Corporation	
Roy W. Reach - Minneapolis Honeywell	
H. J. Smith, Jr. - IBM	
H. Tholstrup - Frieden Incorporated	
Allen L. Whitman - Bell Telephone Laboratories	

NOTE: Mr. E. C. Olofson voluntarily resigned

NMAH
310/1

MINUTES
MEETING OF FEBRUARY 9th & 10th

February 14, 1961

1.2 **Application for Membership**

Mr. W. M. Cahn of Raytheon submitted a letter requesting membership on the committee. Since the ultimate size of the committee is being deliberated and since the committee is desirous of reaching a better balance between users and manufacturers, it was decided by the committee that the question of membership for Mr. Cahn will be tabled for the time being. It was further the decision of the committee that Mr. Cahn should be invited as an observer to the next meeting. The chairman will write Mr. Cahn informing him of the above decisions.

1.3 **Communication User Group**

Mr. Auwaerter is to submit to the chairman a list of the principle communications user groups.

2. **X3 Meeting Report**

The chairman reported on the recent X3 meeting and read a draft scope for the TC 97 committee of the ISO. It was noted that the delegation to represent United States at the forthcoming ISO meeting is being considered. Recommendations for delegees are in order and such recommendations should be forwarded to Mr. Bright of the OEMI. The delegation will be limited to from six to twelve members.

3. **Data Transmission Liaison**

The question of liaison with both groups more directly involved with data communication was brought up. The specific case in point is liaison with the X3-3 data transmission sub-committee. The chairman will look into the matter and report at the next meeting.

4. **EIA - X3-2 Relationship**

4.1 Mr. Tholstrup and the chairman reported on a recent EIA meeting. The EIA TR-27 committee on Computing and Data Processing was discussed. The organization of TR-27 was reviewed. The following sub-committees have been constituted:

TR 22.1	Industrial Process Control Systems Requirements
TR 27.2	Machine Tool Numerical Control Systems Requirements
TR 27.3	Data Transmission Systems and Equipment
TR 27.4	Computation Systems Requirements
TR 27.5	Computing and Information Processing Systems Liaison
TR 27.6	Input-Output Equipment
TR 27.7	Central Processing Equipment

4.2 Mr. Tholstrup reported that the next meetings of the TR 27.6.1-5 sub-committees would be:

New York	March 20 thru 23
Los Angeles	May 9, 10 and 11

5. Each of the members presented his "homework". Each member discussed his proposed coding and the philosophies which led to it.

6. In the course of the deliberations the following points were brought forward:

6.1 It is desirable that the alphabet be in two contiguous quadrants.

6.2 It would be desirable if the binary sequence and the collating sequence of the character set be identical.

6.3 It is desirable that it be possible to expand to or contract from a larger code, starting with the 64 character code.

6.4 It is desirable from a data processing point of view to include the most of the COBOL character set in the basic 64 character set.

6.5 It is generally desirable that the space (that is, the word separator) collate "low", (that is, head of the alphabetic characters.)

6.6 It was noted that in communications, it would be desirable for the alphabet to be in the first and second quadrants or third and fourth quadrants so that it can be identified easily.

6.7 It was noted that the "all one's" code for delete or rub-out was necessary for systems using the paper tape medium.

6.8 Some discussion was held on the point that certain codes could be identified as controls in certain applications and as special character graphics in others.

6.9 It was noted that it would be desirable to maintain the 16 character "numeric set" as a logical sub-set of the 64 character set.

6.10 There was some discussion of the collating sequence for existing files and the effect this should have on a proposed code. It was noted that there may be some historical significance to the special character-alpha-numeric sequence used in many data processing applications. It was identified that further information was required in this area.

7. EIA Standard Proposal for One Inch Paper Tape

This proposal was referred to X3 and hence X3-2 by the ASA and was reviewed. It was generally agreed that it was reasonable. The standard will be reviewed in detail and members are to report at or before the next meeting.

8. March 9th and 10th Meeting

It was the decision of the committee that the March meeting be held in California.

9. Homework

9.1 Each member is to consider the significance in the collating sequence of:

9.1.1 Alpha and numeric sets

9.1.2 The relation of the special characters

9.1.3 Those special characters which must precede the alphabet

9.2 Each member is to consider the significance of the following sorting keys:

A. All alphabetic

B. All numeric

C. Alpha and numeric

D. Alpha, numeric and some special symbols

9.3 Each member is to consider the problems and translations involved in the expansions to or contractions from the following code sets:

4 bit, 6 bit, 7 bit, 8 bit

9.4 Each member is to consider the advisability and problems involved with substituting graphics for control symbols and visa versa.

10. Documents Presented

EIA standards proposal on One Inch Perforated Paper Tape.

C E Macon

C. E. Macon
Secretary

CEM:aks

MEMBERSHIP LIST

Members	Alternates
John Auwaerter Director of Product Development Teletype Corporation 5555 Touhy Avenue Sokokie Illinois	
Leon Bloom National Cash Register Company Electronics Division 1401 East El Segundo Boulevard Hawthorne California	L. S. Mitter Product Planning Department National Cash Register Company Dayton 9 Ohio
L. H. Bonn Remington Rand Univac 1900 West Allegheny Avenue Philadelphia 29 Pennsylvania	Miss D. Hiz Remington Rand Univac 1900 West Allegheny Avenue Philadelphia 29 Pennsylvania
L. L. Griffin Navy Management Office Department of the Navy Washington 25 D. C.	W. E. Velander Navy Management Office Department of the Navy Washington 25 D. C.
H. Kleinberg Mgr., Computing Devices Engr. Radio Corp. of America Electronic Data Processing Division Camden 2 New Jersey	H. Spielman Computing Devices Engr. Radio Corp. of America Electronic Data Processing Division Camden 2 New Jersey
I. C. Liggett Chairman X3-2 IBM Corporation 590 Madison Avenue New York 22 New York	

MEMBERSHIP LIST

Members	Alternates
C. E. Macon Secretary X3-2 Burroughs Corporation ElectroData Division 460 Sierra Madre Villa Pasadena California	R. W. Jack Burroughs Corporation ElectroData Division 460 Sierra Madre Villa Pasadena California
Roy W. Reach Minneapolis Honeywell Electronic Data Processing Division 151 Needham Street Newton Highlands 61 Massachusetts	Thomas McNamara Minneapolish Honeywell Electronic Data Processing Division 151 Needham Street Newton Highlands 61 Massachusetts
H. J. Smith Jr. IBM Corporation 112 East Post Road White Plains New York	R. W. Bemer IBM Corporation 112 East Post Road White Plains New York
L. J. Schoenberg Monroe Calculating Machine Company 555 Mitchell Street Orange New Jersey	
H. Tholstrup Commercial Controls Corporation Frieden Incorporated 1 Leighton Avenue Rochester 2 New York	
Allen L. Whitman Bell Telephone Laboratories 463 West Street New York 14 New York	
B. B. Weber Addressograph-Multigraph Corporation 1200 Babbit Road Cleveland Ohio	

February 20 1961
...ary 20, 1961
... Whitman
A.L. Whitman

ABSTRACT

ASA Subcommittee X3-2, sponsored by the Office Equipment Manufacturers' Association (OEMI) is working to recommend a standard set of 64 characters (6-unit code) for data processing. The current plan is based on a strict binary ordering of the alphabet letters and of the numerals, [illegible] alphas and numerics. The first decision to be made will be on the order of the three major groups, alphas, numerics and "specials" (punctuation and control characters). Later will come the detailed selection of the specials to be included and their assignment to 6-unit codes. Committee recommendations are several months away.

MEMORANDUM FOR FILE

This is an informal interim report on the current work of the ASA Subcommittee X3-2, "Character Sets and Data Formats," sponsored by the Office Equipment Manufacturers' Association (OEMI). Bell System members are R. M. Gryb, John Auwaerter, and Allen Whitman.

Standard Set of 64 Characters

The committee has agreed that its first and immediate task is to recommend a set of 64 characters, together with the associated 6-unit codes. (Consideration of 7-unit and 8-unit codes will come later.)

The characters are being considered in three main groups: letters, called alphas, integers, called numerics, and specials, which include the punctuation and control characters. In passing, it is noted that there is not room in the 64-character set for enough special characters to suit all interests; some compromises will have to be made.

NMAH 310/1

Collating and Sorting

For the operation of data processing machines, the order of characters should lend itself to the collating and sorting of data kept in "files." However, there is not agreement among the business machine people as to the requirements in this respect. There are two basic areas of problems, first the relative order in which the alphas, numerics and specials should appear and second, the specific code assignments within these groups.

The committee has reached these working conclusions:

1. The basic structure of the code will be a succession of binary numbers from 0 through 63.
2. Within this structure the alphas will appear in strict binary order, and the numerics the same.
3. So far as then remains practicable, the specials will be in a single consecutive group; actually, there will be at least two subgroups of specials, at different positions in the binary order.

It is convenient to think separately of the four 16-character subsets which make up the 64-character set. For each of these four, the sets of the four least significant binary digits are the same, representing the decimal numbers 0 through 15. The four subsets are distinguished, in the binary numbers, by the two most significant digits, which are, respectively, 00, 01, 10, and 11.

EIA and Fieldata Codes

In its approach through a binary number framework, the committee is following the precedent already set by a committee of the Electronic Industries Association (whose current recommendations are limited to alphas and numerics) and the so-called Fieldata code of the Armed Forces. A desirable objective would be to have agreement on a common code by all of these three agencies.

So far as ordering of the main groups is concerned, the proposals are as follows, where the letters A, N, and S, refer to alphas, numerics, and specials, respectively.

EIA Proposal (three varieties shown, one favored)

Proposal	A (favored)	SAN
"	B	ANS
"	C	ASN

Fieldata Code

The Fieldata code follows the plan of proposal C, with the order ASN. The Fieldata code, however, also includes specific assignments of special characters for all 64 binary numbers.

Bell System Proposal

The Bell System has presented a complete tentative proposal to the committee; it is essentially the same as the Fieldata 64-character set. Representatives of the Teletype Corporation are negotiating with the military to determine whether changes can be agreed upon so that the two will be identical. Some members of the committee have taken exception to this proposal; further negotiation will be required.

7- and 8-Unit Codes

Nothing in the committees decision to limit its immediate current effort to the determination of a 6-character set implies lack of interest in 7- and 8-unit codes. These will be considered later. Pressure for at least a 7-unit code comes from the fact that it will not be possible to get into the 6-unit code all of the desired punctuation and control characters and some will inevitably spill over into a higher order code.

Standards for the Dimensions of Punched Paper Tape

The committee feels that it has responsibility for standards for the physical dimensions of punched paper tape. Its current work is limited to maintaining liaison with the EIA committee working on these standards (Mr. Henry Tholstrup is a member of both committees) and with the AIEE committee concerned with the same work.

Allen L Whitman
ALLEN L. WHITMAN

NY-3111-ALW-LM

Copies to
Messrs. J. B. Booth - AT&TCo
R. M. Gryb - "
J. F. Auwaerter - Teletype
J. G. Murglin - "
G. K. Burns - MH
T. L. Dimond - MH
C. D. Evjen - NY
R. B. Hearn - WH
W. Y. Lang - NY
W. T. Rea - MH
E. R. Robinson - NY
N. R. Shaer - NY
A. L. Whitman - NY
V. M. Wolontis - MH
W. R. Young, Jr. - NY

JFA 3/13 for your info

BGC 3/28 pls return JFA

file

OEMT NMAH 310/1

HEADQUARTERS
U. S. ARMY SIGNAL RESEARCH AND DEVELOPMENT LABORATORY
FORT MONMOUTH, NEW JERSEY

IN REPLY REFER TO:
~~[illegible]~~
SIGRA/SL-NP

Teletype Corporation
5555 Touhy Avenue
Skokie, Illinois
Attn: Mr. John F. Auwaerter
Director of Product Development

8 MAR 1961

Gentlemen:

Thank you for your letter of 30 December 1960 regarding a new teletypewriter service under consideration by the Bell System. It is pleasing to learn of your hope to use the alpha-numeric portion of the Fieldata code now being published as an addendum to MIL-STD-188A.

The information and plans you have provided as well as the data furnished by Mr. Allen L. Whitman, by letter of 10 January 1961, has been distributed to the membership of the Committee on Military Communication System Technical Standards and other interested military personnel.

The Committee now has your proposal under consideration and as soon as a position is reached, or the need of further discussion is indicated, you will be notified.

Your interest in promoting the compatibility of military and ommercial codes is sincerely appreciated.

Sincerely yours,

John R Bracken for
ROBERT S. BOYKIN, Chairman
Military Communication System
Technical Standards Committee

Copy furnished:
Mr. Allen L. Whitman
Bell Telephone Laboratories
463 West Street, New York, NY

December 30, 1960

Mr. [illegible] E. Boykin, Chairman
Military Communication System Technical Standards Committee
Deputy Director of Communication Department
USASRDL
Fort Monmouth, New Jersey

Dear Mr. Boykin:

In recent conversations at Fort Monmouth, we informed Messrs. Cracken and Burkhard that the Bell System has under consideration a new teletypewriter service making use of a 4-row, typewriter layout keyboard with single-case printing. The keyboard arrangement being considered is shown in the attached drawing and is essentially identical to a standard electric typewriter. A 6 level code alphabet will be needed to permit sending both letters and figures without a printer case shift signal.

In order to promote compatibility between military and commercial record communications, we hope to use the alpha-numeric portion of the 6-bit Fieldata code now being published as an addendum to MIL STD-188A. We must, however, deviate from this code in the permutations assigned to symbols. These permutations must be chosen to provide a uniform, one bit difference between each numeric and the symbol associated with that numeric on the keytop. This is necessary in the interests of low cost keyboard design. A copy of the proposed new code is attached.

In the national interest we would plan to use the Fieldata code except in the symbol area where its adoption would preclude use of the commercial typewriter keyboard arrangement and thus would represent a significant economic disadvantage. We suggest that you consider modifying the Fieldata code in the symbol area in order to achieve essential compatibility with future commercial communications systems. We would, of course, be happy to work with you to this end.

Yours very truly

ORIGINAL SIGNED BY
J. F. AUWAERTER
Director of Product Development

JFA:BW

Encs.